Cleaning Sheet, System and Apparatus

Field of the Invention

The present invention relates to cleaning sheets, implements for cleaning surfaces and a method of cleaning surfaces. More particularly the present invention relates to disposable cleaning sheets, implements for use in wet surface-cleaning applications or dry surface cleaning applications and a method of cleaning surfaces using the disposable cleaning sheets and cleaning implements of the present invention.

Background of the Invention

Disposable cleaning sheets have heretofore been used in connection with cleaning tools such as mops and brushes. As an example, US Patent No. 5,461,749 to Ahlberg et al. discloses a floor mop or fabric for picking-up and retaining dust. The cleaning fabric can be attached to a mop head thereby allowing the mop to be used in as a "duster", i.e. a tool or fabric for picking-up dust and other particulate matter. Once the cleaning fabric is soiled, it can be removed from the mop head and a new, clean sheet placed therein. A similar product is disclosed in published PCT Application WO97/04701 to Suzuki et al. This publication discloses a flat bag-like cleaning cloth having an insertion space. The head portion of a handle is inserted within the insertion space to form a cleaning apparatus for use as a duster. As a further example, published PCT Application WO98/52548 discloses a sheet material having a macroscopically three-dimensional structure suitable for use a duster in conjunction with a handle or other cleaning tool.

In addition, US Patent No. 4,823,427 to Gibbs et al. teaches the use of an absorbent elastic mop head cover that can be secured to the mop head without fasteners. The

elastic mop head cover can comprise a meltblown fiber fabric and, in one embodiment, can include absorbent materials such as wood pulp or synthetic staple fibers in order to increase the water or oil absorbency of the fabric. While Gibbs provides a durable cleaning sheet suitable for use in wet and/or dry cleaning applications, cleaning sheets having improved durability and an improved capacity to pick up larger and/or coarser particulate matter are desirable. Thus, there exists a need for cleaning sheets and implements suitable for use in dry or wet surface-cleaning applications which are highly durable, capable of absorbing liquids and further which are also capable of picking up dirt and large particulate matter. Still further, there exists a need for such a cleaning sheet that is also sufficiently inexpensive so as to comprise a disposable product.

Summary of the Invention

The present invention provides a cleaning sheet that has an enhanced dirt, dust and/or debris pick-up and retention characteristics, which can be used in dry applications and/or wet applications.

It has been discovered, as a result of the present invention, a cleaning sheet comprising a nonwoven web comprising a plurality of multicomponent multilobal filaments, wherein the multicomponent multilobal filaments comprises a plurality of raised lobal regions separated by depressed regions and the nonwoven web comprises voids between the plurality of multicomponent multilobal filaments has enhanced dirt, dust and/or debris pick-up and retention.

In a further aspect of the present invention, it has been discovered that a cleaning sheet comprising a nonwoven web comprising a mixture of a plurality of multicomponent multilobal filaments, and a plurality of monolobal filaments, wherein the multicomponent multilobal filaments comprises a plurality of raised lobal regions separated by depressed regions and the nonwoven web comprises voids between the plurality of multicomponent filaments and/or the monolobal filaments has enhanced dirt, dust and/or debris pick-up and retention.

Further discovered is a multilayered cleaning sheet comprising a first layer comprising a plurality of multicomponent multilobal filaments, wherein the multicomponent multilobal filaments comprises a plurality of raised lobal regions separated by depressed regions and the layer comprises voids between the plurality of multicomponent filaments, and a second layer comprising monolobal filaments also has enhanced dirt, dust and/or debris pick-up and retention.

The present invention also relates to a cleaning implement comprising a handle; a head; and a removable cleaning sheet; wherein the head is connected to the handle, and the removable cleaning sheet is removably attached to the head. The cleaning sheet comprises a nonwoven web comprising a plurality of multicomponent multilobal filaments, wherein each of the filaments comprises a plurality of raised lobal regions separated by depressed regions and the nonwoven web comprises voids between the plurality of multicomponent filaments which allow for enhanced dirt, dust and/or debris pick-up and retention.

A further aspect of the present invention relates a method of cleaning a surface comprising contacting and wiping the surface with the cleaning sheet of the present invention.

The present invention also relates to a kit containing the cleaning implement of the present invention and a plurality of the cleaning sheets of the present invention.

Brief Descriptions of the Drawings

Fig. 1 illustrates cross-section shapes of several different multilobal fibers suitable for the nonwoven web cleaning sheet of the present invention.

Fig. 2 illustrates one process for producing the nonwoven web used in the cleaning sheet of the present invention.

Fig. 3 illustrates a cleaning implement of the present invention.

Definitions

As used herein, the term “cleaning sheet” or “wiping sheet” is intended to include any web which is used to clean an article or a surface. Examples of cleaning sheets include, but are not limited to, webs of material containing a single sheet of material which is used to clean a surface by hand or a sheet of material which can be attached to a cleaning implement, such as a floor mop or a hand held cleaning tool, such as a duster.

As used herein, the term “fiber” includes both staple fibers, i.e., fibers which have a defined length between about 2 and about 20 mm, fibers longer than staple fiber but are not continuous, and continuous fibers, which are sometimes called “continuous filaments” or simply “filaments”. The method in which the fiber is prepared will determine if the fiber is a staple fiber or a continuous filament.

As used herein, the term "nonwoven web" means a web having a structure of individual fibers or threads which are interlaid, but not in an identifiable manner as in a

knitted web. Nonwoven webs have been formed from many processes, such as, for example, meltblowing processes, spunbonding processes, and bonded carded web processes. The basis weight of nonwoven webs is usually expressed in ounces of material per square yard (osy) or grams per square meter (gsm) and the fiber diameters useful are usually expressed in microns, or in the case of staple fibers, denier. It is noted that to convert from osy to gsm, multiply osy by 33.91.

The term "denier" is defined as grams per 9000 meters of a fiber. For a fiber having circular cross-section, denier may be calculated as fiber diameter in microns squared, multiplied by the density in grams/cc, multiplied by 0.00707. A lower denier indicates a finer fiber and a higher denier indicates a thicker or heavier fiber. Outside the United States the unit of measurement is more commonly the "tex," which is defined as the grams per kilometer of fiber. Tex may be calculated as denier/9. The "mean fiber denier" is the sum of the deniers for each fiber, divided by the number of fibers.

As used herein, the term "bulk density" refers to the weight of a material per unit of volume and is generally expressed in units of mass per unit bulk volume (e.g., grams per cubic centimeter).

As used herein, the term "spunbonded fibers" refers to fibers which are formed by extruding molten thermoplastic material as filaments from a plurality of fine, usually circular capillaries of a spinneret with the diameter of the extruded filaments then being rapidly reduced as by, for example, U.S. Patent 4,340,563 to Appel et al., and U.S. Patent 3,692,618 to Dorschner et al., U.S. Patent 3,802,817 to Matsuki et al., U.S. Patents 3,338,992 and 3,341,394 to Kinney, U.S. Patent 3,502,763 to Hartman; U.S. Patent 3,542,615 to Dobo et al.; and U.S. Patent 5,382,400 to Pike et al.; the entire content of each is incorporated herein by reference. Spunbond fibers are generally not tacky when they are deposited onto a collecting surface. Spunbond fibers are generally continuous and have average diameters (from a sample of at least 10) larger than 7 microns to about 50 or 60 microns, often, between about 15 and 25 microns.

As used herein, the term "meltblown fibers" means fibers formed by extruding a molten thermoplastic material through a plurality of fine, usually circular, die capillaries as molten threads or filaments into converging high velocity, usually hot, gas (e.g. air) streams which attenuate the filaments of molten thermoplastic material to reduce their diameter, which may be to microfiber diameter. Thereafter, the meltblown fibers are carried by the high velocity gas stream and are deposited on a collecting surface to form a web of randomly dispersed meltblown fibers. Such a process is disclosed, for example, in U.S. Pat. No. 3,849,241. Meltblown fibers are microfibers, which may be continuous or

discontinuous, and are generally smaller than 10 microns in average diameter, and are generally tacky when deposited onto a collecting surface.

As used herein, the term "polymer" generally includes, but is not limited to, homopolymers, copolymers, such as for example, block, graft, random and alternating copolymers, terpolymers, etc. and blends and modifications thereof. Furthermore, unless otherwise specifically limited, the term "polymer" shall include all possible geometrical configurations of the molecule. These configurations include, but are not limited to isotactic, syndiotactic and random symmetries.

As used herein, the term "conjugate fibers" refers to fibers or filaments which have been formed from at least two polymers extruded from separate extruders but spun together to form one fiber. Conjugate fibers are also sometimes referred to as "multicomponent" or "bicomponent" fibers or filaments. The term "bicomponent" means that there are two polymeric components making-up the fibers. The polymers are usually different from each other though conjugate fibers may be prepared from the same polymer, but the polymers are different from one another in some physical property, such as, for example, melting point or the softening point. The polymers are arranged in substantially constantly positioned distinct zones across the cross-section of the multicomponent fibers or filaments and extend continuously along the length of the multicomponent fibers or filaments. The configuration of such a multicomponent fiber may be, for example, a sheath/core arrangement, wherein one polymer is surrounded by another, a side-by-side arrangement, a pie arrangement or an "islands-in-the-sea" arrangement. Multicomponent fibers are taught in U.S. Pat. No. 5,108,820 to Kaneko et al., U.S. Pat. No. 5,336,552 to Strack et al., and U.S. Pat. No. 5,382,400 to Pike et al., the entire content of each is incorporated herein by reference. For two component fibers or filaments, the polymers may be present in ratios of 75/25, 50/50, 25/75 or any other desired ratios.

As used herein, the term "multiconstituent fibers" refers to fibers which have been formed from at least two polymers extruded from the same extruder as a blend or mixture. Multiconstituent fibers do not have the various polymer components arranged in relatively constantly positioned distinct zones across the cross-sectional area of the fiber and the various polymers are usually not continuous along the entire length of the fiber, instead usually forming fibrils or protofibrils which start and end at random.

As used herein, the term "hot air knife" or HAK means a process of preliminarily bonding a just produced microfiber web, particularly spunbond, in order to give it sufficient integrity, i.e. increase the stiffness of the web, for further processing, but does not mean

the relatively strong bonding of secondary bonding processes like through-air bonding, thermal bonding and ultrasonic bonding. A hot air knife is a device which focuses a stream of heated air at a very high flow rate, generally from about 1000 to about 10,000 feet per minute (fpm) (305 to 3050 meters per minute), or more particularly from about 3000 to 6000 feet per minute (915 to 1830 meters per minute) directed at the nonwoven web immediately after the nonwoven web formation. The air temperature is usually in the range of the melting point of at least one of the polymers used in the web, generally between about 200° and 550° F. (93° and 290° C.) for the thermoplastic polymers commonly used in spunbonding. However, the temperature of the air must be adjusted accordingly for the particular polymers used to prepare the nonwoven web. The control of air temperature, velocity, pressure, volume and other factors helps avoid damage to the web while increasing its integrity. The HAK's focused stream of air is arranged and directed by at least one slot of about 1/8 to 1 inches (3 to 25 mm) in width, particularly about 3/8 inch (9.4 mm), serving as the exit for the heated air towards the web, with the slot running in a substantially cross-machine direction over substantially the entire width of the web. In other embodiments, there may be a plurality of slots arranged next to each other or separated by a slight gap. At least one slot is usually, though not essentially, continuous, and may be comprised of, for example, closely spaced holes. The HAK has a plenum to distribute and contain the heated air prior to its exiting the slot. The plenum pressure of the HAK is usually between about 1.0 and 12.0 inches of water (2 to 22 mmHg), and the HAK is positioned between about 0.25 and 10 inches and more preferably 0.75 to 3.0 inches (19 to 76 mm) above the forming wire. In a particular embodiment the HAK plenum's cross sectional area for cross-directional flow (i.e. the plenum cross sectional area in the machine direction) is at least twice the total slot exit area. Since the forming wire onto which spunbond polymer is formed generally moves at a high rate of speed, the time of exposure of any particular part of the web to the air discharged from the hot air knife is less a tenth of a second and generally about a hundredth of a second in contrast with the through-air bonding process which has a much larger dwell time. The HAK process has a great range of variability and controllability of many factors such as air temperature, velocity, pressure, volume, slot or hole arrangement and size, and the distance from the HAK plenum to the web. The HAK is further described in U.S. Patent 5,707,468 to Arnold et al., the entire contents of which is incorporated by reference.

As used herein, through-air bonding or "TAB" means a process of bonding a nonwoven fiber web in which air, which is sufficiently hot to melt one of the polymers of which the fibers of the web are made, is forced through the web. The air velocity is

between 100 and 500 feet per minute and the dwell time may be as long as 10 seconds. The melting and resolidification of the polymer provides the bonding. Through-air bonding has relatively restricted variability and since through-air bonding requires the melting of at least one component to accomplish bonding, it is generally restricted to webs with two components like multicomponent fibers or those which include an adhesive. In the through-air bonder, air having a temperature above the melting temperature of one component and below the melting temperature of another component is directed from a surrounding hood, through the web, and into a perforated roller supporting the web. Alternatively, the through-air bonder may be a flat arrangement wherein the air is directed vertically downward onto the web. The operating conditions of the two configurations are similar, the primary difference being the geometry of the web during bonding. The hot air melts the lower melting polymer component and thereby forms bonds between the filaments to integrate the web.

As used herein “thermal point bonded” means bonding one or more fabrics with a pattern of discrete bond points. As an example, thermal point bonding often involves passing a fabric or web of fibers to be bonded at a nip between a pair of heated bonding calender rolls. One of the bonding rolls is usually, though not always, patterned in some way so that the entire fabric is not bonded across its entire surface, and the second or anvil roll is usually a smooth surface. As a result, various patterns for calender rolls have been developed for functional as well as aesthetic reasons. One example of a pattern has points and is the Hansen Pennings or "H&P" pattern with about a 30% bond area with about 200 bonds/square inch as taught in U.S. Patent 3,855,046 to Hansen and Pennings. The H&P pattern has square point or pin bonding areas wherein each pin has a side dimension of 0.038 inches (0.965 mm), a spacing of 0.070 inches (1.778 mm) between pins, and a depth of bonding of 0.023 inches (0.584 mm). The resulting pattern has a bonded area of about 29.5%. Another typical point bonding pattern is the expanded Hansen Pennings or "EHP" bond pattern which produces a 15% bond area with a square pin having a side dimension of 0.037 inches (0.94 mm), a pin spacing of 0.097 inches (2.464 mm) and a depth of 0.039 inches (0.991 mm). Another typical point bonding pattern designated "714" has square pin bonding areas wherein each pin has a side dimension of 0.023 inches, a spacing of 0.062 inches (1.575 mm) between pins, and a depth of bonding of 0.033 inches (0.838 mm). The resulting pattern has a bonded area of about 15%. Yet another common pattern is the C-Star pattern which has a bond area of about 16.9%. The C-Star pattern has a cross-directional bar or "corduroy" design interrupted by shooting stars. Other common patterns include a diamond pattern with repeating and slightly offset diamonds with about a 16%

bond area and a wire weave pattern, having generally alternating perpendicular segments, with about a 19% bond area. Typically, the percent bonding area varies from around 10% to around 30% of the area of the fabric laminate web. Point bonding may be used to hold the layers of a laminate together and/or to impart integrity to individual layers by bonding filaments and/or fibers within the web.

As used herein "pattern unbonded" or interchangeably "point unbonded" or "PUB", means a fabric pattern having continuous bonded areas defining a plurality of discrete unbonded areas. The fibers or filaments within the discrete unbonded areas are dimensionally stabilized by the continuous bonded areas that encircle or surround each unbonded area, such that no support or backing layer of film or adhesive is required. The unbonded areas are specifically designed to afford spaces between fibers or filaments within the unbonded areas. A suitable process for forming the pattern-unbonded nonwoven material includes providing a nonwoven fabric or web, providing opposedly positioned first and second calender rolls and defining a nip there between, with at least one of said rolls being heated and having a bonding pattern on its outermost surface comprising a continuous pattern of land areas defining a plurality of discrete openings, apertures or holes, and passing the nonwoven fabric or web within the nip formed by said rolls. Each of the openings in said roll or rolls defined by the continuous land areas forms a discrete unbonded area in at least one surface of the nonwoven fabric or web in which the fibers or filaments of the web are substantially or completely unbonded. Stated alternatively, the continuous pattern of land areas in said roll or rolls forms a continuous pattern of bonded areas that define a plurality of discrete unbonded areas on at least one surface of said nonwoven fabric or web. The PUB pattern is further described in U.S. Patent 5,858,515 to Stokes et al, the entire contents of which are hereby incorporated by reference.

As used herein, the term “debris” means items which typically need removal during a cleaning process. This term is intended to include, but is not limited to, hair (both human and pet), dandruff (both human and pet), food particles, e.g. crumbs from bread, cakes cookies and the like, grass, dirt, defoliated skin, and other such items.

Detailed Description

The inventors of the present invention have discovered that nonwoven webs formed from multicomponent, multilobal shaped fibers have an enhanced dirt, dust and/or debris pickup and retention within the nonwoven web. Furthermore, the multicomponent, multilobal shaped fibers are also shaped in ways meant to enhance liquid retention.

These properties provide for a cleaning sheet which can be used in both dry and wet applications, which provide enhance and effective dirt, dust and/or debris pickup and retention, while, at the same time, can also provide absorbency of liquids. The multicomponent, multilobal shaped fibers have "lobes" separated by depressed regions which allow the nonwoven web to absorb liquids and hold the absorbed liquids in place within the nonwoven structure. Tips of the multicomponent, multilobal shaped fibers increase surface area which provides for enhance surface contact, which in turn provides for the enhanced dirt, dust and/or debris pickup of the cleaning sheet. In addition, the multilobal shape of the fibers also creates voids within the nonwoven web structure which allows for dirt, dust and/or debris retention within the nonwoven web.

The shaped fibers of the present invention may be spunbond fibers made from at least two polymers as multicomponent fibers and have at least one lobe capable of holding liquid. Multicomponent fibers may be split, crimped and through-air bonded among many other properties and bonding options. Combining the advantages of the liquid and particle pick-up and retention of multilobal fibers with the processing advantages of multicomponent fiber results in a nonwoven web which has highly desirable properties needed in cleaning sheets. In addition, the fibers of the present invention have improved processibility and can provide a myriad of different nonwoven webs having properties which can be tailored to the needs of the end user.

The spunbond process generally uses a hopper which supplies polymer to a heated extruder. The extruder supplies melted polymer to a spinneret where the polymer is fiberized as it passes through fine openings arranged in one or more rows in the spinneret, forming a curtain of filaments. The filaments are usually quenched with air at a low pressure, drawn, usually pneumatically and deposited on a moving foraminous mat, belt or "forming wire" to form the nonwoven web. Polymers useful in the spunbond process commonly have a process melt temperature of between about 400°F to about 610°F (200°C to 320°C).

The fibers produced in the spunbond process are usually in the range of from about 5 to about 50 microns in average diameter, depending on process conditions and the desired end use for the webs to be produced from such fibers. For example, increasing the polymer molecular weight or decreasing the processing temperature results in larger diameter fibers. Changes in the quench fluid temperature and pneumatic draw pressure can also affect fiber diameter. The fibers used in the practice of this invention usually have average diameters in the range of from about 7 to about 35 microns, more particularly from about 15 to about 25 microns.

The fibers used to produce the web of this invention are multicomponent fibers. As these multicomponent fibers are produced and cooled, the differing coefficients of expansion of the polymers can cause these fibers to bend and ultimately to crimp, somewhat akin to the action of the bimetallic strip in a conventional room thermostat. Crimped fibers are described in U.S. Pat. No. 5,382,400 wherein fibers are crimped with the same air as is used to draw them. Sufficiently warm drawing air activates the latent helical crimp of the fibers as the fibers are produced and before they are deposited on the forming wire. Crimped fibers have an advantage over uncrimped fibers in that they produce a more bulky web, thereby increasing the void spacing within the nonwoven web. Larger void spacing is a desirable characteristic for cleaning sheets, since the larger voids will allow for the pickup and retention of larger particles of dirt, dust and/or debris. Therefore, crimped fibers are somewhat more desirable than uncrimped fibers in cleaning sheets. Additionally, the degree of crimp can be controlled by controlling the temperature of the drawing air, thereby providing a mechanism for controlling the web density. Generally, a higher air temperature produces a higher number of crimps. This allows one to change the resulting bulk density, and void size distribution of the resulting cleaning sheet by simply adjusting the temperature of the air in the fiber draw unit.

In the present invention, the nonwoven web cleaning sheets will typically have a bulk density of about 0.01 to about 0.2 g/cm^3. Preferably, the cleaning sheets with have a bulk density of about 0.015 to about 0.075 g/cm^3 and ideally about 0.02 to about 0.05 g/cm^3.

The nonwoven web cleaning sheets of the present invention may have basis weights ranging from about 0.25 osy (8.5 gsm) to about 25 osy (850 gsm). The actual basis weight of the nonwoven material is dependent of the final use of the cleaning sheet. It is desirable that the basis weight be in the range from about 0.5 osy (17 gsm) to about 10 osy (340 gsm), and preferably about 1.0 osy (34 gsm) to about 5 osy (170 gsm), for many applications.

The multicomponent, multilobal shape of the fibers used in the practice of this invention must provide areas in which dirt, dust and/or debris can be retained and/or where liquids may be retained. Preferred shapes are those described in U.S. Pat. Nos. 5,069,970 and 5,057,368 to Largman et al., assigned to Allied Signal, Inc., hereby incorporated by reference in their entirety, which describe fibers with unconventional shapes. In addition, shaped fibers are also described in U.S. Patent Nos. 5,314,743, 5,342,336 and 5,458,963 to Meirowitz et al., hereby incorporated by reference in their entirety. None of these patents, however, suggest multicomponent fibers or the unique

advantages of such fibers in crimping, varying web pore size or bonding and which are important factors determining the usefulness of such fibers when used to create a nonwoven web cleaning sheet. Multicomponent shaped fibers are known in the art and have been used in filter fabrics as is shown in U.S. Patent 5,707,735 to Midkiff et al, which is also hereby incorporated by reference in its entirety. Fibers having the shapes and configurations of the '735 patent may also be used in the present invention. Generally, the multilobal fibers of the present in invention will have between 2 and 10 lobes, but preferably have between 2 and 5 lobes. Other examples of multicomponent, shaped fibers which can be used in the present invention are shown in FIG 1.

Referring to FIG 1(a), a bilobal bicomponent nonwoven fiber 100 is shown in cross-section. The fiber 100 has two lobes 112 and 114, and depressed regions 116 and 118 on both sides of fiber 110 between the lobes. A boundary line 119 indicates the interface between a polymer component forming one of the lobes 112 and 114, and a polymer component forming the other lobe. The polymer components of the fiber are arranged side-by-side.

FIG 1(b) illustrates, in cross-section, a trilobal bicomponent nonwoven fiber 120 in which the three lobes 122, 124 and 126 are positioned at right angles to each other. A depressed region 123 is located between the lobes 122 and 124. A depressed region 125 is located between the lobes 122 and 126. It should be apparent from Fig. 1(b), for instance, that the term "depressed region" refers to a region which is concave with respect to a straight line drawn tangential to the two adjacent lobes. In Fig. 1(b), a straight line 127 can be drawn tangential to adjacent lobes 122 and 124, with concave portion 123 underneath the straight line. A similar straight line can be drawn tangential to adjacent lobes 122 and 126. However, no concave region exists with respect to a straight line drawn tangential to adjacent lobes 124 and 126. In Fig. 1(b), the dividing line 129 represents an interface between a polymer component forming half of the fiber, and a polymer component forming the other half of the fiber. Again, the polymer components of the fiber are arranged in a side-by-side configuration.

FIG 1(c) illustrates, in cross-section, a trilobal bicomponent nonwoven fiber 130 in which the three lobes 132, 134 and 136 are positioned at 60-degree angles to each other. A depressed region 133 is located between lobes 132 and 134. A depressed region 135 is located between lobes 132 and 136. A depressed region 137 is located between lobes 134 and 136. A dividing line 139 represents an interface between a polymer forming half of the fiber 130, and a polymer forming the other half. Again, the fiber 130 has a side-by-side distribution of the polymer components.

FIG 1(d) illustrates, in cross-section, a quadrilobal bicomponent fiber 140 in which the four lobes 142, 144, 146 and 148 are arranged in a star-like configuration. Depressed regions 141, 143, 145 and 147 are formed between each pair of adjacent lobes. A circular dividing line 149 represents an interface between the polymer components. In this instance, the bicomponent fiber has a sheath-core configuration with one polymer forming the core and the other polymer forming the sheath.

FIG 1(e) illustrates, in cross-section, a quadrilobal bicomponent fiber 150 in which the four lobes 152, 154, 156 and 158 are arranged in a cross configuration. Depressed regions 151, 153, 155 and 157 are formed between each pair of adjacent lobes. Dividing line 159 represents the interface between polymer components, which are arranged in a side-by-side configuration.

FIG 1(f) illustrates, in cross-section, a pentalobal bicomponent fiber 160 having five lobes 162, 164, 166, 168 and 170 arranged at approximately 72-degree angles to each other. Depressed regions 161, 163, 165, 167 and 169 are formed between each pair of adjacent lobes. Dividing line 171 represents the interface between the polymer components which are arranged in a side-by-side configuration.

FIG 1(g) illustrates, in cross-section, a quadrilobal bicomponent fiber 180 in which the four lobes 182, 184, 186 and 188 are arranged in a cross configuration. Depressed regions 181, 183, 185 and 187 are formed between each pair of adjacent lobes. Dividing lines 189 represents the interface between polymer components, which are arranged in a sheath/ core configuration.

FIG 1(h) illustrates, in cross-section, a pentalobal bicomponent fiber 200 having five lobes 202, 204, 206, 208 and 210 arranged at approximately 72-degree angles to each other. Depressed regions 201, 203, 205, 207 and 209 are formed between each pair of adjacent lobes.. Dividing line 211 represents the interface between the polymer components which are arranged in a sheath/core configuration.

It is pointed out that the shape of the fibers which can be used in the present invention are not limited to the specific shape or configurations shown in Figure 1. Other shapes and configurations of the multicomponent, multilobal shaped fibers can, so long as the resulting nonwoven web has an ability to pick-up and retain dirt, dust and/or debris and/or to absorb and retain fluids.

The polymers suitable for the present invention include polyolefins, polyesters, polyamides, polycarbonates, polyurethanes, polyvinylchloride, polytetrafluoroethylene, polystyrene, polyethylene terephathalate, biodegradable polymers such as polylactic acid and copolymers and blends thereof Suitable polyolefins include polyethylene, e.g., high

density polyethylene, medium density polyethylene, low density polyethylene and linear low density polyethylene; polypropylene, e.g., isotactic polypropylene, syndiotactic polypropylene, blends of isotactic polypropylene and atactic polypropylene, and blends thereof; polybutylene, e.g., poly(1-butene) and poly(2-butene); polypentene, e.g., poly(1-pentene) and poly(2-pentene); poly(3-methyl-1-pentene); poly(4-methyl 1-pentene); and copolymers and blends thereof. Suitable copolymers include random and block copolymers prepared from two or more different unsaturated olefin monomers, such as ethylene/propylene and ethylene/butylene copolymers. Suitable polyamides include nylon 6, nylon 6/6, nylon 4/6, nylon 11, nylon 12, nylon 6/10, nylon 6/12, nylon 12/12, copolymers of caprolactam and alkylene oxide diamine, and the like, as well as blends and copolymers thereof. Suitable polyesters include polyethylene terephthalate, polytrimethylene terephthalate, polybutylene terephthalate, polytetramethylene terephthalate, polycyclohexylene-1,4-dimethylene terephthalate, and isophthalate copolymers thereof, as well as blends thereof.

Many polyolefins are available for fiber production, for example polyethylenes such as Dow Chemical's ASPUN 6811A linear low-density polyethylene, 2553 LLDPE and 25355 and 12350 high density polyethylene are such suitable polymers. The polyethylenes have melt flow rates in g/10 min. at 190° F. and a load of 2.16 kg, of about 26, 40, 25 and 12, respectively. Fiber forming polypropylenes include Exxon Chemical Company's ESCORENE PD3445 polypropylene. Many other polyolefins are commercially available and generally can be used in the present invention. The particularly preferred polyolefins are polypropylene and polyethylene.

Examples of polyamides and their methods of synthesis may be found in "Polymer Resins" by Don E. Floyd (Library of Congress Catalog number 66-20811, Reinhold Publishing, N.Y., 1966). Particularly commercially useful polyamides are nylon 6, nylon-6,6, nylon-11 and nylon-12. These polyamides are available from a number of sources such as Custom Resins, Nyltech, among others. In addition, a compatible tackifying resin may be added to the extrudable compositions described above to provide tackified materials that autogenously bond or which require heat for bonding. Any tackifier resin can be used which is compatible with the polymers and can withstand the high processing (e.g., extrusion) temperatures. If the polymer is blended with processing aids such as, for example, polyolefins or extending oils, the tackifier resin should also be compatible with those processing aids. Generally, hydrogenated hydrocarbon resins are preferred tackifying resins, because of their better temperature stability. REGALREZ® and ARKON® P series tackifiers are examples of hydrogenated hydrocarbon resins. ZONATAC® 501 lite

is an example of a terpene hydrocarbon. REGALREZ® hydrocarbon resins are available from Hercules Incorporated. ARKON®P series resins are available from Arakawa Chemical (USA) Incorporated. The tackifying resins such as disclosed in U.S. Pat. No. 4,787,699, hereby incorporated by reference, are suitable. Other tackifying resins which are compatible with the other components of the composition and can withstand the high processing temperatures, can also be used.

In addition, the lobes may be made from particular polymers which are hydrophilic or which may be treated for hydrophilicity which will enhance the ability of the nonwoven web to absorb aqueous liquids.

The polymers used to make the nonwoven web may contain additives, such as surfactants or slip agents, to aid in the sliding of the sensitive surface against the nonwoven material. Other additives, such as pigments, dyes, processing aids and the like can be added to the polymer prior to fiber formation, provided that the additives do not adversely affect the ability of the nonwoven web to pickup and retain dirt, dust and/or debris and/or the ability of the nonwoven web to absorb liquids. Ferroelectric materials, such as those disclosed in U.S. Patent. 6, 162,535 to Turkevich et al, assigned to the assignee of this invention, and is incorporated in its entirety by reference, may also be added to fibers. In addition, other polymeric additives, such as maleic anhydride telomers may also be added, for example to provide electret stability.

It is desirable that the particular polymers used for the different components of the fibers in the practice of the invention have melting points different from one another. This is important not only in producing crimped fibers but also when through-air bonding is used as the bonding technique, wherein the lower melting polymer bonds the fibers together to form the fabric or web. It is desirable that the lower melting point polymers makes up at least a portion of the outer region of the fibers. More particularly, the lower melting component should be located in an outer portion of the fiber so that it comes in contact with other fibers. For example, in a sheath/core fiber configuration, the lower melting point polymer component should be located in the sheath portion. In a side-by-side configuration, the lower melting point polymer will inherently be located on an outer portion of the fiber.

The proportion of higher and lower melting polymers in the multicomponent, multilobal fibers can range between about 10-90% by weight higher melting polymer and 10-90% lower melting polymer. In practice, only so much lower melting polymer is needed as will facilitate bonding between the fibers. Thus, a suitable fiber composition may contain about 40-80% by weight higher melting polymer and about 20-60% by weight

lower melting polymer, desirably about 50-75% by weight higher melting polymer and about 25-50% by weight lower melting polymer.

In a preferred embodiment, a first polymer, which is the lower melting point polymer is polyethylene and the higher melting point polymer is polypropylene. This embodiment is preferred from the standpoint of cost and resulting properties of the cleaning sheet.

After the fibers are formed and deposited on the forming wire and create the web of this invention, the web may be passed through a hot air knife or HAK to very slightly consolidate the web and provide the web with enough integrity for further processing. After deposition but before HAK treatment, the fiber web has low stiffness which makes its difficult, if not impossible, to successfully convert on commercially available converting equipment commonly used to the final use. The application of the HAK allows forming a web of fibers to deliver high stiffness by melting only a portion of the lower melting component in the web, preferably only that lower melting component on the side facing the HAK air, in a pre- or primary bonding step. This HAK step creates a zone of pre-bonded fibers located on one side of the web which then undergo a second melting when exposed to through-air bonding or bonding with a heated bonding roll, such as a roll which will impart a PUB pattern to the nonwoven web or a roll which imparts a thermal point bonded pattern to the web. The exposure of this zone to at least two heating and melting cycles is believed to create a zone of high stiffness in the web from the crystallization of the polymer, however, since the zone is comprised of a small percentage of the total web, the effect on bulk density of the web is minimized. This differs from the commonly used method of increasing the integrity of a web known as compaction rolls since, while compaction rolls increase the stiffness of a web, the compaction rolls also increase the bulk density of the web. It is noted, however, that while compaction rolls may be used in the practice of this invention, the HAK is generally preferred since the HAK does not reduce the void spacing of the web while compaction rolls will reduce the void spacing. After treatment with the HAK, the web is sufficiently cohesive to move it to the next step of production; the secondary bonding step. Any secondary bonding known to those skilled in the art can be used.

The secondary bonding procedure which may be used in the practice of this invention is preferably through-air bonding because it does not appreciably reduce web void (pore) size. When used with HAK pre-bonding, through-air bonding very effectively produces high stiffness in the web since it provides a second heating of the polymer previously heated by the HAK and provides sufficient heat to bond fibers not bonded by

the HAK. This creates bonds at almost every fiber crossover point, thereby restricting movement of the majority of the fibers of the web.

Other secondary bonding methods can be used without limitation. Examples of other secondary bonding methods include PUB bonding and thermal point bonding. In the PUB pattern, a continuous bond area is formed with a plurality of discrete unbonded areas. Thermal point bonding by contrast results has discrete bonding points, and a continuous unbonded area.

Through-air bonding is preferred secondary bonding because it does not appreciably reduce void size when compared, for example, to thermal point bonding. Through-air bonding creates small bonds at almost every fiber crossover point, minimally effecting the void size within the nonwoven web structure. Thermal point bonding by contrast results in comparatively large bonds at discrete points, compressing the web in areas around the bond points which decreases the void size at or near the bond points.

After the secondary bonding, the nonwoven web may be electret treated. Electret treatment further increases ability of the nonwoven web to pick-up and retain dirt, dust and/or debris by drawing the dirt, dust and/or debris into the nonwoven web by virtue of their electrical charge. Electret treatment can be carried out by a number of different techniques. One technique is described in U.S. Pat. No. 5,401,446 to Tsai et al. assigned to the University of Tennessee Research Corporation and incorporated herein by reference in its entirety. Tsai describes a process whereby a web or film is sequentially subjected to a series of electric fields such that adjacent electric fields have substantially opposite polarities with respect to each other. Thus, one side of the web or film is initially subjected to a positive charge while the other side of the web or film is initially subjected to a negative charge. Then, the first side of the web or film is subjected to a negative charge and the other side of the web or film is subjected to a positive charge. Such webs are produced with a relatively high charge density without an attendant surface static electrical charge. The process may be carried out by passing the web through a plurality of dispersed non-arcing electric fields which may be varied over a range depending on the charge desired in the web. The web may be charged at a range of about 1 kVDC/cm to about 30 kVDC/cm or more particularly about 4 kVDC/cm to about 12 kVDC/cm and still more particularly about 7 kVDC/cm to about 8 kVDC/cm.

Electret charge stability can be further enhanced by grafting polar end groups onto the polymers of the multicomponent fibers. In addition, barium titanate and other polar materials may be blended with the polymers to enhance the electret treatment. Suitable

blends are described in U.S. Patent. 6,162,535 to Turkevich et al, assigned to the assignee of this invention and in PCT Publication WO 00/00267 to Myers et al.

Other methods of electret treatment are known in the art such as that described in U.S. Pat. Nos. 4,215,682 to Kubik et al, U.S. Pat. No. 4,375,718 to Wadsworth, U.S. Pat. No. 4,592,815 to Nakao and U.S. Pat. No. 4,874,659 to Ando, each hereby incorporated in its entirety by reference.

Electret treatment is desirable if the cleaning sheet is to be used as a dry wiping sheet, since the charge in the cleaning sheet will tend to attract the dirt, dust and/or other debris to the cleaning sheet. In contrast, if the cleaning sheet is to be used as a wet cleaning sheet, then electret treatment is generally not desired. It is pointed out, however, that a dry wiping sheet does not have to be electret treated and a wet cleaning sheet may be electret treated.

The multicomponent, multilobal shaped fibers of the nonwoven web used as a cleaning sheet in the present invention can optionally be split or fibrillated. Split or fibrillated fine fibers exhibit highly desirable properties, including textural, visual and strength properties. There are different known processes for producing split fine fibers, and in general, split fibers are produced from multicomponent fibers which contain two or more incompatible polymer components or from an axially oriented film. For example, a known method for producing split fibrous structures includes the steps of forming splittable multicomponent filaments into a fabric and then treating the fabric with an aqueous emulsion of benzyl alcohol or phenyl ethyl alcohol to split the multicomponent filaments. Another known method has the steps of forming splittable multicomponent filaments into a fibrous structure and then splitting the multicomponent filaments by flexing or mechanically working the filaments in the dry state or in the presence of a hot aqueous solution. Yet another commercially utilized method for producing split fine denier fibers is a needling process. In this process, multicomponent fibers are hydraulically or mechanically needled to separate the different polymer components of the multicomponent fibers. Further yet another method for producing fine fibers, although it may not be a fiber splitting process, utilizes multicomponent fibers that contain a solvent or water soluble polymer component. For example, a fibrous structure is produced from sheath-core multicomponent fibers and then the fibrous structure is treated with a solvent that dissolves the sheath component to produce a fibrous structure of fine denier fibers of the core component. For the purposes of this invention, split multicomponent fibers may be produced from any method which is effective.

The nonwoven web of this invention may be produced from the multicomponent, multilobal shaped fibers alone, or in combination with other fibers, such as thermoplastic monolobal fibers. The addition of the monolobal fibers to the multicomponent, multilobal shaped fibers helps improves the strength of the resulting nonwoven web. The monolobal fibers can be monocomponent fibers or can be multicomponent fibers. Preferably, the monolobal fibers are multicomponent fibers made from the same components as the multicomponent multilobal shaped fibers. As with the multicomponent multilobal shaped fibers, a portion of the outer layer should have a lower melting point polymer. The preferred monolobal fibers desirably have a substantially circular cross-sectional shape.

When the monolobal fibers are present in the nonwoven web, the nonwoven web cleaning sheet comprises from about 1 to about 99 % by weight of the multicomponent, multilobal shaped fibers and about 99 to about 1% of the monolobal fibers. Preferably, the nonwoven web cleaning sheet comprises from about 5 to about 95 % by weight of the multicomponent, multilobal shaped fibers and about 95 to about 5% of the monolobal fibers More preferably, the nonwoven web cleaning sheet contains from about 30 to about 75 % by weight of the multicomponent multilobal shaped fibers and about 70 to about 25% of the round shaped fibers.

The cleaning sheets of the present invention have a surface area of at least 0.210 m^2/g. Generally, the surface are generally in the range of about 0.220 m^2/g to about 0.500 m^2/g, and more particularly, in the range of about 0.250 m^2/g to about 0.350 m^2/g.

Other fibers such as natural fibers may also be incorporated into the thermoplastic multicomponent, multilobal shaped fibers. Examples of such natural fibers include, for example, cellulosic, such as pulp fibers. The addition of natural fibers can improve the liquid absorbency of the cleaning sheet. Various pulp fibers can be utilized including, but not limited to, thermomechanical pulp fibers, chemithermomechanical pulp fibers, chemimechanical pulp fibers, refiner mechanical pulp fibers, stone groundwood pulp fibers, peroxide mechanical pulp fibers and so forth. If other fibers are included in the nonwoven web cleaning sheet of the present invention, these fibers should make up less than 50% by weight of the nonwoven web.

Turning to FIG 2, a process line 10 for preparing an embodiment of the present invention is disclosed. The process line 10 is arranged to produce multicomponent continuous filaments, but it should be understood that the present invention comprehends nonwoven fabrics made with multicomponent filaments having more than two components. For example, the fabric of the present invention can be made with filaments having three or four components. The process line 10 includes a pair of extruders 12a and

12b for separately extruding a polymer component A and a polymer component B. Polymer component A is fed into the respective extruder 12a from a first hopper 14a and polymer component B is fed into the respective extruder 12b from a second hopper 14b. Polymer components A and B are fed from the extruders 12a and 12b through respective polymer conduits 16a and 16b to a spinneret 18. The spinneret 18 has openings arranged in one or more rows. The spinneret openings form a downwardly extending curtain of filaments when the polymers are extruded through the spinneret. For the purposes of the present invention, spinneret 18 may be arranged to form side-by-side or eccentric sheath/core multicomponent filaments, for example.

The process line 10 also includes a quench blower 20 positioned adjacent the curtain of filaments extending from the spinneret 18. Air from the quench air blower 20 quenches the filaments extending from the spinneret 18. The quench air can be directed from one side of the filament curtain as shown in FIG 2, or both sides of the filament curtain.

A fiber draw unit or aspirator 22 is positioned below the spinneret 18 and receives the quenched filaments. Fiber draw units or aspirators for use in melt spinning polymers are well-known as discussed above. Suitable fiber draw units for use in the process of the present invention include a linear, fiber aspirator of the type shown in U.S. Pat. No. 3,802,817 or U.S. Pat. No. 4,340,563 and eductive guns of the type shown in U.S. Pat. Nos. 3,692,618 and 3,423,266, each hereby incorporated by reference in its entirety. Generally described, the fiber draw unit 22 includes an elongate vertical passage through which the filaments are drawn by aspirating air entering from the sides of the passage and flowing downwardly through the passage. A blower 24 supplies hot aspirating air to the fiber draw unit 22. The hot aspirating air draws the filaments and ambient air through the fiber draw unit.

An endless forming surface 26 is positioned below the fiber draw unit 22 and receives the continuous filaments from the outlet opening of the fiber draw unit. The forming surface 26 travels around guide rollers 28. A vacuum 30 positioned below the forming surface 26 where the filaments are deposited draws the filaments against the forming surface.

The process line 10 as shown also includes a hot-air knife 34 which provides a degree of integrity to the web. In addition, the process line includes a bonding apparatus which is a through-air bonder 36. After passing through the through-air bonder, the web is passed between a charging wire or bar 48 and a charged roller 42 and then between a

second charging wire or bar 50 and roller 44. As is stated above, the electret treatment is an optional process step and is not required.

Lastly, the process line 10 includes a winding roll 42 for taking up the finished fabric.

To operate the process line 10, the hoppers 14a and 14b are filled with the respective polymer components A and B. Polymer components A and B are melted and extruded by the respective extruders 12a and 12b through polymer conduits 16a and 16b and the spinneret 18. Although the temperatures of the molten polymers vary depending on the polymers used, when polypropylene and polyethylene are used as components A and B respectively, the preferred temperatures of the polymers range from about 370° to about 530°F. and preferably range from 400° to about 450° F.

As the extruded filaments extend below the spinneret 18, a stream of air from the quench air blower 20 at least partially quenches the filaments to develop a latent helical crimp in the filaments at an air temperature of about 45° to about 90° F and a velocity from about 100 to about 400 feet per minute.

After quenching, the filaments are drawn into the vertical passage of the fiber draw unit 22 by a flow of hot air from the heater 24 through the fiber draw unit. The fiber draw unit is preferably positioned 30 to 60 inches below the bottom of the spinneret 18. The temperature of the air supplied from the heater 24 is sufficient that, after some cooling due to mixing with cooler ambient air aspirated with the filaments, the air heats the filaments to a temperature required to activate the latent crimp. The temperature required to activate the latent crimp of the filaments ranges from about 110° F. to a maximum temperature less that the melting point of the lower melting component which for through-air bonded materials is the second component B. The temperature of the air from the heater 24 and thus the temperature to which the filaments am heated can be varied to achieve different levels of crimp. Generally, a higher air temperature produces a higher number of crimps. The ability to control the degree of crimp of the filaments is a particularly advantageous feature of the present invention because it allows one to change the resulting density, pore size distribution and drape of the fabric by simply adjusting the temperature of the air in the fiber draw unit.

The crimped filaments are deposited through the outlet opening of the fiber draw unit 22 onto the traveling forming surface 26. The vacuum 30 draws the filaments against the forming surface 26 to form an unbonded, nonwoven web of continuous filaments. The web is then given a degree of integrity by the hot-air knife 34 and through-air bonded in the through-air bonder 36.

In the through-air bonder 36, air having a temperature above the melting temperature of component B and below the melting temperature of component A is directed from the hood 40, through the web, and into the perforated roller 38. Alternatively, the through-air bonder may be a flat arrangement wherein the air is directed vertically downward onto the web. The operating conditions of the two configurations are similar, the primary difference being the geometry of the web during bonding. The hot air melts the lower melting polymer component B and thereby forms bonds between the multicomponent filaments to integrate the web. When polypropylene and polyethylene are used as polymer components A and B respectively, the air flowing through the through-air bonder usually has a temperature ranging from about 230° F to about 325° F (110° C to 162° C) and a velocity from about 100 to about 500 feet per minute. It should be understood, however, that the parameters of the through-air bonder depend on factors such as the type of polymers used and thickness of the web. The web may optionally then be passed through the charged field between the charging bar or wire 48 and the charging drum or roller 42 and then through a second charged field of opposite polarity created between charging bar or wire 50 and charging drum or roller 44. The web may be charged at a range of about 1 kVDC/cm to 30 kVDC/cm.

Lastly, the finished web is wound onto the winding roller 42 and is ready for further processing or use.

As is noted above, the HAK may be replaced with a compacting roll, however a HAK is preferred to the compacting roll for the reasons stated above.

The cleaning sheet of this invention may be a multilayer laminate and may be formed by a number of different techniques including but not limited to using adhesive, needle punching, ultrasonic bonding, thermal calendering and through-air bonding. Such a multilayer laminate may be an embodiment wherein some of the layers are spunbond and some meltblown such as a spunbond/meltblown/spunbond (SMS) laminate as disclosed in U.S. Pat. No. 4,041,203 to Brock et al. and U.S. Pat. No. 5,169,706 to Collier, et al., each hereby incorporated by reference. The SMS laminate may be made by sequentially depositing onto a moving conveyor belt or forming wire first a spunbond web layer, then a meltblown web layer and last another spunbond layer and then bonding the laminate in a manner described above.

Alternatively, the three web layers may be made individually, collected in rolls and combined in a separate bonding step.

In a preferred multilayer laminate, two layers of spunbond webs are joined together, with or without the meltblown layer. One of the spunbond layers is a layer of

multicomponent multilobal shaped fibers and another of the layers is a layer of monolobal fibers. The layer of multicomponent multilobal shaped fibers gives the resulting nonwoven web the ability to pick-up and retain dirt, dust and/or debris, and the layer of monolobal fibers imparts strength to the laminate. Preferably, the layer of the multicomponent multilobal shaped fibers is adjacent to the layer of monolobal fibers. It is further pointed out that the layer of monolobal fibers may be monocomponent fibers or multicomponent fibers. In addition, the layer of multicomponent, multilobal fibers may optionally contain other fibers described above.

In another alternative laminate structure of the present invention, the cleaning sheet may also have a barrier layer. The liquid barrier layer desirably comprises a material that substantially prevents the transmission of liquids under the pressures and chemical environments associated with surface cleaning applications. Desirably, the liquid barrier layer comprises a thin, monolithic film. The film desirably comprises a thermoplastic polymer such as, for example, polyolefins (e.g., polypropylene and polyethylene), polycondensates (e.g., polyamides, polyesters, polycarbonates, and polyarylates), polyols, polydienes, polyurethanes, polyethers, polyacrylates, polyacetals, polyimides, cellulose esters, polystyrenes, fluoropolymers and so forth. Desirably, the film is hydrophobic. Additionally, the film desirably has a thickness less than about 2 mil and still more desirably between about 0.5 mil and about 1 mil. As a particular example, the liquid barrier layer can comprise an embossed, polyethylene film having a thickness of approximately 1 mil.

The liquid barrier layer can be bonded together with the other layer or layers of the cleaning sheet to form an integrated laminate through the use of adhesives. In a further aspect, the layers can be attached by mechanical means such as, for example, by stitching. Still further, the multiple layers can be thermally and/or ultrasonically laminated together to form an integrated laminate. The method of bonding is not critical to the present invention.

The size and shape of the cleaning sheet can vary with respect to the intended application and/or end use of the same. Desirably, the cleaning sheet has a substantially rectangular shape of a size which allows it to readily engage standard cleaning equipment or tools such as, for example, mop heads, duster heads, brush heads and so forth. As one particular example, in order to fit a standard mop head, the cleaning sheet may have a length of about 28 cm and a width of about 22 cm. However, the particular size and/or shape of cleaning sheet can vary as needed to fit upon or otherwise conform to a specific cleaning tool. In an alternative configuration, the cleaning sheet of the present invention

could be formed into a mitten shaped article for wiping and cleaning, which would fit over the users hand.

As indicated herein above, the cleaning sheets of the present invention are well suited for use with a variety of cleaning equipment and, more particularly, is readily capable of being releasably-attached to the head of a cleaning tool. As used herein, "releasably-attached" or "releasably-engaged" means that the sheet can be readily affixed to and thereafter readily removed from the cleaning tool. In reference to FIG 3, cleaning tool 240 can comprise handle 248, head 244 and fasteners 246. Cleaning sheet 243 can be superposed with and placed against head 244 such that the liquid barrier layer, if present, faces head 244. If the cleaning sheet is a multilayer laminate, the side of the sheet with the multicomponent, multilobal fibers should face away from the head. Flaps 247 can then be wrapped around head 244 and releasably-attached to head 244 by fasteners 246, e.g. clamps. With cleaning sheet 243 affixed to head 244, cleaning tool 240 can then be used in one or more wet and/or dry cleaning operations. Thereafter, when the cleaning sheet becomes heavily soiled or otherwise spent, the used sheet can be quickly and easily removed and a new one put in its place. The specific configuration of the cleaning tool can vary in many respects. As examples, the size and/or shape of the handle can vary, the head can be fixed or moveable (e.g. pivotable) with relation to the handle, the shape and/or size of the head can vary, etc. Further, the composition of the head can itself vary, as but one example the head can comprise a rigid structure with or without additional padding. Further, the mechanism(s) for attaching the cleaning sheet can vary and exemplary means of attachment include, but are not limited to, hook and loop type fasteners (e.g. VELCRO ™ fasteners), clamps, snaps, buttons, flaps, cinches, low tack adhesives and so forth.

The cleaning sheets of the present invention are well suited for a variety of dry and wet cleaning operations such as: mopping floors; cleaning of dry surfaces: cleaning and drying wet surfaces such as counters, tabletops or floors (e.g. wet surfaces resulting from spills); sterilizing and/or disinfecting surfaces by applying liquid disinfectants; wiping down and/or cleaning appliances, machinery or equipment with liquid cleansers; rinsing surfaces or articles with water or other diluents (e.g. to remove cleaners, oils, etc.), removing dirt, dust and/or other debris and so forth. The cleaning sheets have numerous uses as a result of its combination of physical attributes, especially the uptake and retention dirt, dust and/or debris. Additionally, the cleaning sheet provides a durable cleaning surface with good abrasion resistance. This combination of physical attributes is highly advantageous for cleaning surfaces with or without liquids such as soap and water or

other common household cleaners. Further, the cleaning fabrics of the present invention are of a sufficiently low cost to allow disposal after either a single use or a limited number of uses. By providing a disposable cleaning sheet it is possible to avoid problems associated with permanent or multi-use absorbent products such as, for example, cross-contamination and the formation of bad odors, mildew, mold, etc.

The cleaning sheets of the present invention are also effective in cleaning floors used for athletics, such as gym floors, indoor basketball courts, aerobic floors and the like, which usually become slippery due to the presence of dust, dirt and/or other debris on the floor, as well as liquids such as water and/or sweat. The cleaning sheets of the present invention are very effective in cleaning such floor surfaces since the sheet has the ability to pick-up and retain dirt, dust , debris and liquids.

The cleaning sheets can be provided dry or pre-moistened. In one aspect, dry cleaning sheets can be provided with dry or substantially dry cleaning or disinfecting agents coated on or in the multicomponent multilobal fiber layer. In addition, the cleaning sheets can be provided in a pre-moistened and/or saturated condition. The wet cleaning sheets can be maintained over time in a sealable container such as, for example, within a bucket with an attachable lid, sealable plastic pouches or bags, canisters, jars, tubs and so forth. Desirably the wet, stacked cleaning sheets are maintained in a resealable container. The use of a resealable container is particularly desirable when using volatile liquid compositions since substantial amounts of liquid can evaporate while using the first sheets thereby leaving the remaining sheets with little or no liquid. Exemplary resealable containers and dispensers include, but are not limited to, those described in U.S. Patent No. 4,171,047 to Doyle et al., U.S. Patent No. 4,353,480 to McFadyen, U.S. patent 4,778,048 to Kaspar et al., U.S. Patent No. 4,741,944 to Jackson et al., U.S. Patent No. 5,595,786 to McBride et al.; the entire contents of each of the aforesaid references are incorporated herein by reference. The cleaning sheets can be incorporated or oriented in the container as desired and/or folded as desired in order to improve ease of use or removal as is known in the art.

With regard to pre-moistened sheets, a selected amount of liquid is added to the container such that the cleaning sheets contain the desired amount of liquid. Typically, the cleaning sheets are stacked and placed in the container and the liquid subsequently added thereto. The sheet can subsequently be used to wipe a surface as well as act as a vehicle to deliver and apply cleaning liquids to a surface. The moistened and/or saturated cleaning sheets can be used to treat various surfaces. As used herein “treating” surfaces is used in the broad sense and includes, but is not limited to, wiping, polishing, swabbing,

cleaning, washing, disinfecting, scrubbing, scouring, sanitizing, and/or applying active agents thereto. The amount and composition of the liquid added to the cleaning sheets will vary with the desired application and/or function of the wipes. As used herein the term "liquid" includes, but is not limited to, solutions, emulsions, suspensions and so forth. Thus, liquids may comprise and/or contain one or more of the following: disinfectants; antiseptics; diluents; surfactants, such as nonionic, anionic, cationic, waxes; antimicrobial agents; sterilants; sporicides; germicides; bactericides; fungicides; virucides; protozoacides; algicides; bacteriostats; fungistats; virustats; sanitizers; antibiotics; pesticides; and so forth. Numerous cleaning compositions and compounds are known in the art and can be used in connection with the present invention.

The cleaning sheets of the present invention can be provided in a kit form, wherein a plurality of cleaning sheets and a cleaning tool are provided in a single package.

Example

Cleaning sheets from multilobal multicomponent fibers were produced and compared to cleaning sheets produced from multicomponent round fibers and commercially available nonwoven cleaning sheets. The multilobal multicomponent fibers were prepared using a pentalobal shaped spinneret and contain 60% by weight polypropylene and 40% by weight polyethylene in a side-by-side configuration, using the process disclosed in U.S. Patent 5,597,645 to Pike et al, assigned to the assignee of the present application. The fibers were through-air-bonded and were electret treated. The basis weight of the resulting nonwoven web cleaning sheet was 1.5 osy (51 gsm) and the surface area is about 0.275 m^2/g

The cleaning sheets from round multicomponent fibers were prepared using a round spinnerett and contain 50% by weight polypropylene and 50% by weight polyethylene in a side-by-side configuration, using the process disclosed in U.S. Patent 5,382,400 to Pike et al, assigned to the assignee of the present application. The fibers were through-air-bonded and were electret treated. The basis weight of the resulting nonwoven web cleaning sheet was 1.8 osy (61 gsm) and the surface area is about 0.219 m^2/g.

The prepared cleaning sheets were compared to commercially available cleaning sheets using the following test. The Swiffer ™ had a surface area of about 0.154 m^2/g, the Pledge Grab-It ™ had a surface are of about 0.206 m^2/g and the Vileda ® Exstatic Cloth had a surface area of about 0.3075 m^2/g. Ten samples of each sheet were compared. A tray having a 18"x 24" linoleum floor surface with Lexan polycarbonates sides which were 1.5" high was used to test the pick-up of the cleaning sheets. A 8.5"X 11" sample of each

cleaning sheet was attached to the same mop head and handle assembly. A measured amount of debris, mixed hair clippings from a barbershop or commercially dried and packed bread crumbs were place onto the tray. The amount of hair clipping in the each of the 10 samples tested for each cleaning sheet ranged from 0.1g to 0.14g and the bread crumbs ranged from 0.2 g to 0.28 g. The tray was swept twice in the same fashion with each cleaning sheet and carefully removed from the cleaning implement. The amount of debris pick-up was calculated for each sample. The results are shown in Table 1 for the hair pick-up and Table 2 for the bread crumb pick-up. As can be seen from the Tables below, the cleaning sheet of the present invention has an enhanced debris pick-up as compared to the commercially available cleaning sheets and the cleaning sheet prepared from monolobal round fibers. It is further shown in the Tables that the pick-up of the cleaning sheets of the present invention is superior to cleaning sheets having smaller, larger or about the same surface area as the cleaning sheets of the present invention.

TABLE 1

Cleaning Sheet Sample	Average % of hair pick-up
Present invention from bicomponent, multimodal shaped fibers	86.6%
Comparative example from round bicomponent fibers	57.9%
Swiffer ™ [1]	79.0%
Pledge Grab-It ™ [2]	80.8%
Vileda ® Exstatic Cloth ™ [3]	35.1%

[1] Available from Procter & Gamble Company, Cincinnati, Ohio
[2] Available from S.C. Johnson, Racine, Wisconsin
[3] Available from Freudenberg Household Products, River Grove, Illinois

TABLE 2

Cleaning Sheet Sample	Average % of crumb pick-up
Present invention from bicomponent, multilobal shaped fibers	63.4%
Comparative example from round bicomponent fibers	50.5%
Swiffer ™ [1]	39.2 %
Pledge Grab-It ™ [2]	36.1%
Vileda ® Exstatic Cloth ™ [3]	22%

[1] Available from Procter & Gamble Company, Cincinnati, Ohio
[2] Available from S.C. Johnson, Racine, Wisconsin
[3] Available from Freudenberg Household Products, River Grove, Illinois

While the invention has been described in detail with respect to specific embodiments thereof, and particularly by the example described herein, it will be apparent to those skilled in the art that various alterations, modifications and other changes may be made without departing from the spirit and scope of the present invention. It is therefore intended that all such modifications, alterations and other changes be encompassed by the claims.